Recent Developments in MODIS, AIRS/AMSU, and AMSR-E processing software for EOS Direct Broadcast

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October 4, 2005

International EOS/NPP Direct Readout Meeting

Cast and Crew

NASA MODIS Science Team (SDST, MCST)

NASA AIRS Science Team
(Steve Friedman, Evan Manning, Quyen Nguyen)

NASA GSFC Direct Readout Laboratory and DAAC
(P. Coronado, K. Brentzel, C. Lynnes)

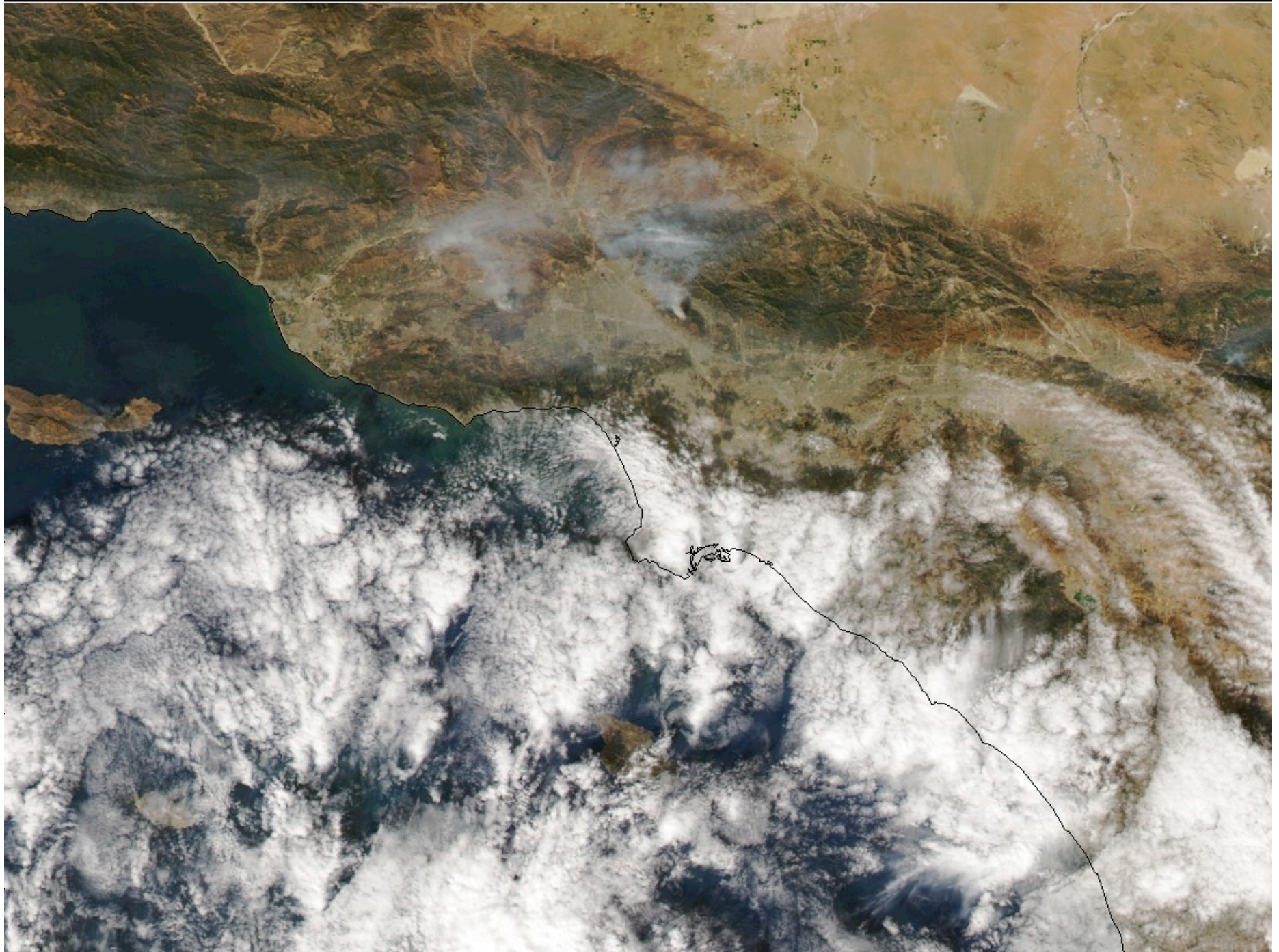**NASA GSFC Ocean Biology Processing Group (OBPG)**
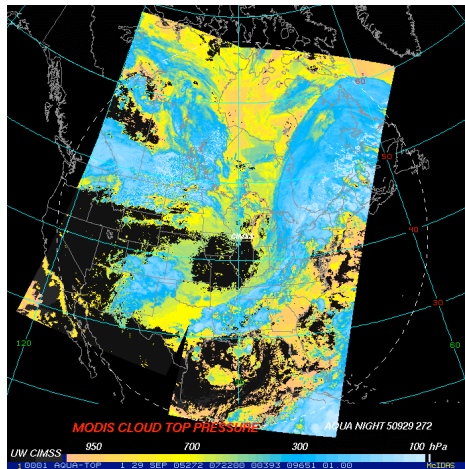**(G. Feldman, M. MacDonald, B. Franz, M. Ruebens)**

SSEC UW-Madison
(A. Huang, K. Strabala, T. Rink, J. Davies, J. Huang)
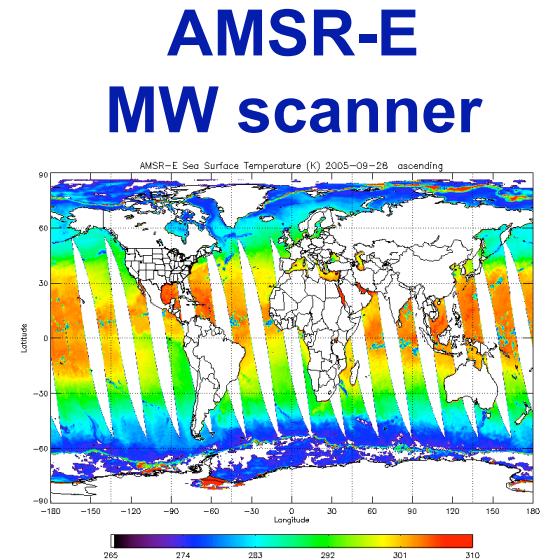
Remote Sensing Systems
(F. Wentz, P. Ashcroft)

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This briefing describes recent updates to the software packages available for processing EOS Terra/Aqua direct broadcast data
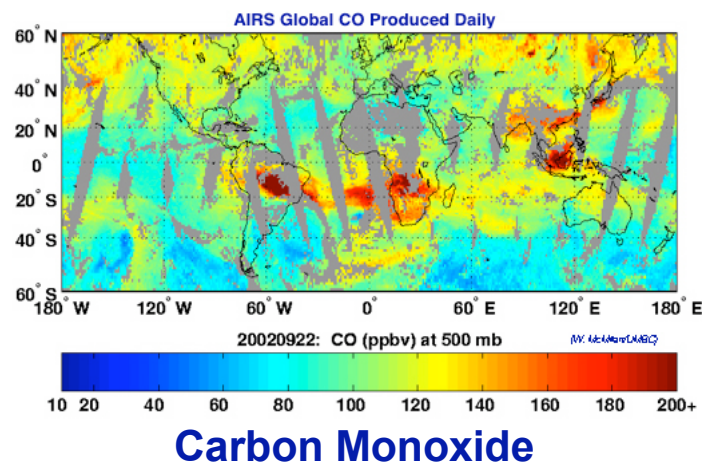

MODIS
Vis/NIR/IR imager

Cloud Top Pressure

AMSR-E
MW scanner

Sea Surface Temperature

AIRS, AMSU
IR and MW sounder

Carbon Monoxide

MODIS (Terra, Aqua) DB Software Updates

Software packages updated recently include:

MODIS Level 1 DB processing
(unpack, geolocation, calibration)
Updated 26 September 2005

MODIS Level 2 DB processing; *IMAPP version*
(cloud mask, cloud top properties, temperature and moisture profiles)
Updated 30 August 2005

AIRS Level 1 & 2 DB processing
(unpack, geolocation, calibration, temperature and moisture profiles; trace gases)
Updated 22 September 2005

AMSR-E Level 1 & 2 DB processing
(unpack, geolocation, calibration, rain rate)
Updated 6 July 2005

MODIS Level-1 processing software available until recently in three different versions:

1. GSFC DAAC
  - Linux port of DAAC version; tuned for DB
  - Data format is standard HDF4
  - Challenging to install and run
  - Updates are not frequent

2. IMAPP
  - Multi-platform port of DAAC version; tuned for DB
  - Data format is modified HDF4 (metadata reformatted)
  - Easier to install and run (but not ideal)
  - No updates since Nov. 2003

3. SeaDAS (since v4.4)
  - Multi-platform port of DAAC version; tuned for DB in v4.8
  - Data format is standard HDF4
  - Easy to install and run
  - Updates are timely
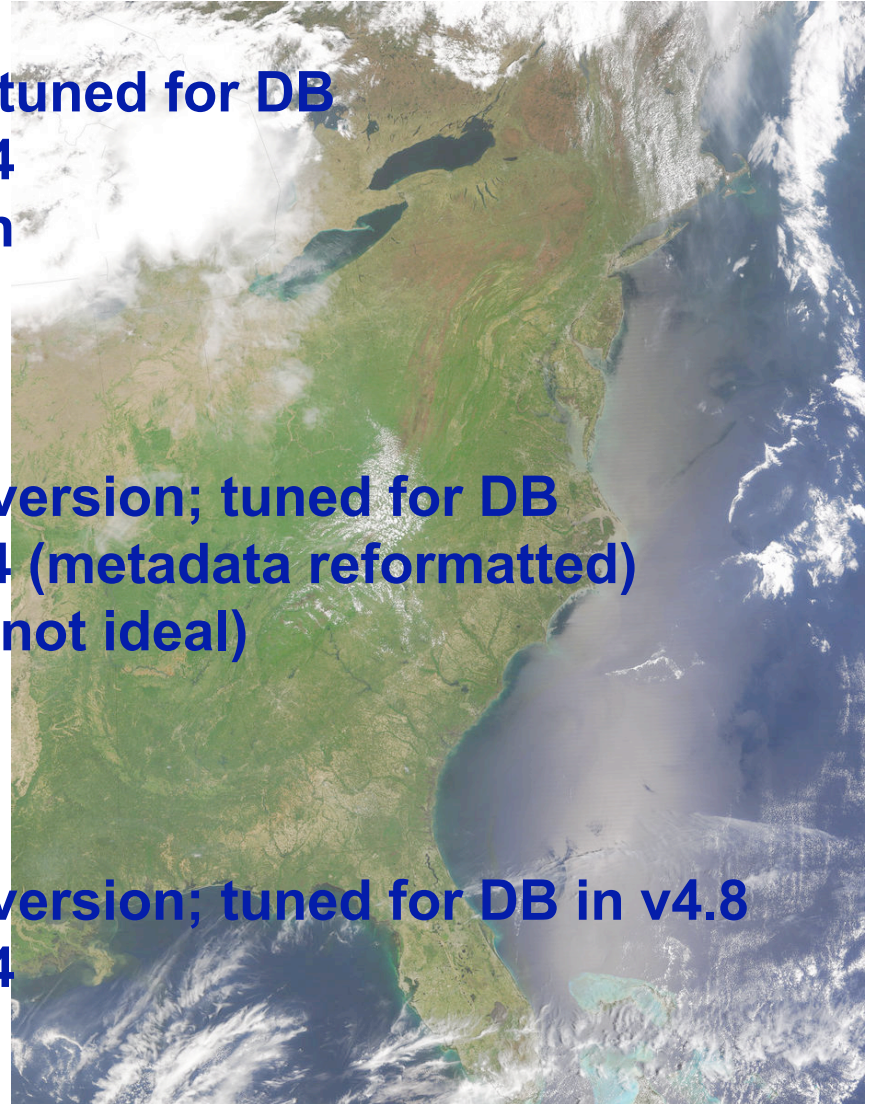
It was decided to converge the MODIS Level 1 software from 3 distributions to 1

Goals:
- **Multi-platform (including Intel Linux)**
- **Easy to install and run**
- **Binary distribution; source code available separately**
- **Standard DAAC HDF4 formats**
- **Well maintained and up to date (latest calibration LUTs)**
- **Tuned for DB environment (e.g., runs in real time)**
- **Appropriate for Land, Ocean, Atmosphere**

Method:
- **Use SeaDAS 4.8 as the base (maintained by OBPG)**
- **New wrapper scripts which can be used for real-time or post-processing**
- **Only small changes to the DAAC version of the code**
- **Terrain correction is enabled by default; but can be disabled**
- **Supported platforms: Intel Linux, Solaris, and OS X!**

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For more information, see the following talk:

Bryan Franz and Michael MacDonald
"NASA Support for MODIS Direct Broadcast:
Level 0 to Standard Ocean Products"

Tuesday 4:15 pm

MODIS Level 2 software in IMAPP was recently brought up to date for "Collection 5"

Cloud Mask

For polar night scenes, two new spectral tests using the 7.2 micron water vapor absorption band have been added as well as updates to the 3.9-12 micron and 11-12 micron cloud tests.

Land and sea surface temperature ancillary data provide crucial information for night-time middle and low-level cloud detection and lessen dependence on ocean brightness temperature variability tests.

Sun-glint identification is improved by use of SST ancillary data to identify regions where visible and NIR reflectances are high, but infrared window brightness temperatures are relatively warm.

Aqua MODIS
**Cloud Mask**
2005/09/29 (night)

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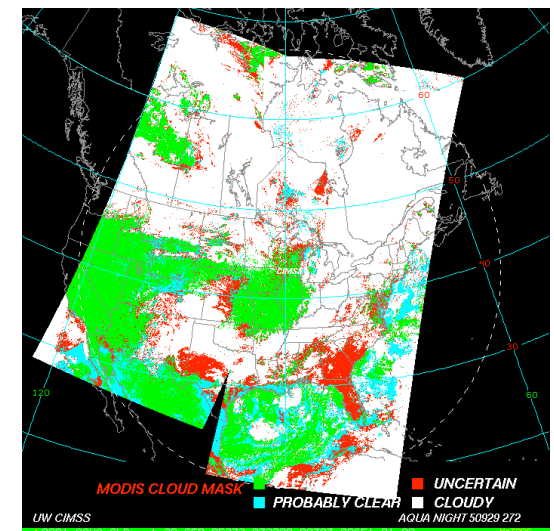
Atmospheric Profiles

Training data updated with more profiles and better
characterization of surface emissivity. Training
data and retrievals are now also partitioned into
separate land and ocean classes, and new BT
zones are used. Updated radiance bias values are
used.

Reduced the moist bias for dry cases and
improved moisture retrievals in the tropics. The
polar total ozone retrieval was significantly
improved and overestimates reduced.

Total precipitable water retrievals now compare
more favorably to surface measurements at the
SGP CART site, with RMS errors in TPW reduced
to around 3 mm.

Aqua MODIS
**Total Precipitable Water**
2005/09/29 (night)
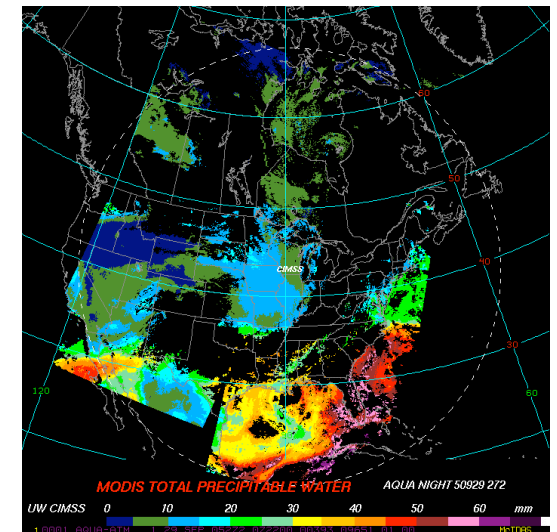
Cloud Top Properties

New fast transmittance model coefficients are used and the number of forward calculations is reduced for efficiency. Simple land vs.. water surface emissivity correction is applied

Now reads all levels of GDAS ancillary profiles, and surface parameters (temperatures, pressures) are bi-linearly interpolated to smooth surface input.

More accurate saturation water vapor pressure calculation is applied.

**Aqua MODIS
Cloud Top Pressure
2005/09/29 (night)**

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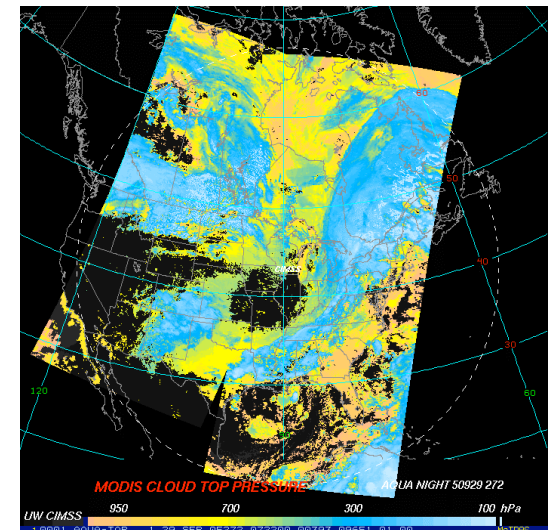
AIRS/AMSU (Aqua) DB Software Updates

AIRS Level 1 & 2 software for DB was recently brought up to date for "Version 4"
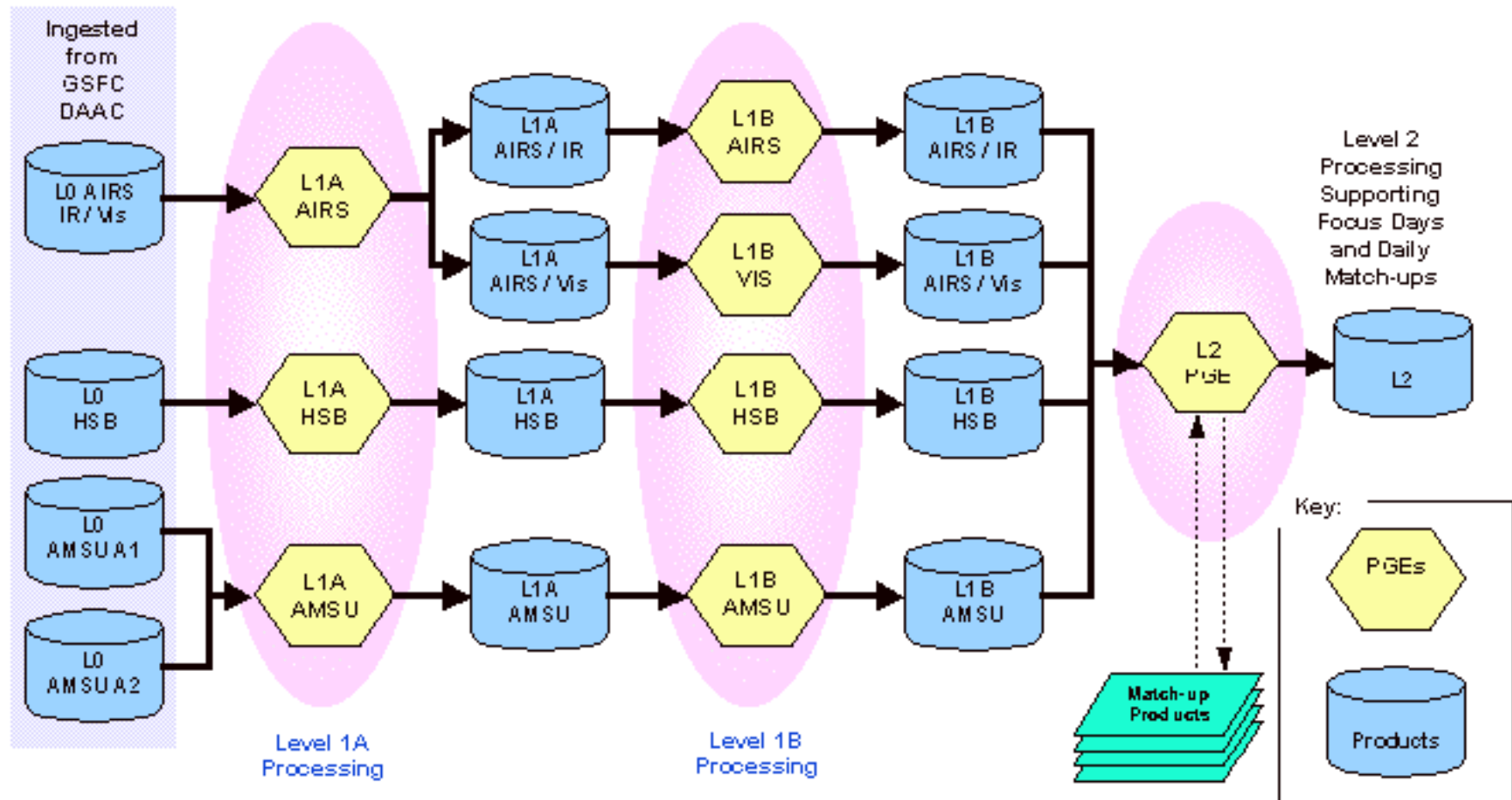
Temperature is validated to 1K in 1 km vertical layers over ocean.
Water vapor is validated to 15% in 2 km vertical layers over ocean.
Improved retrievals over land and improved cloud properties.

S. Hemisphere 500mb AC Z
20S - 80S   Waves 1-20
1 Jan - 31 Jan '04
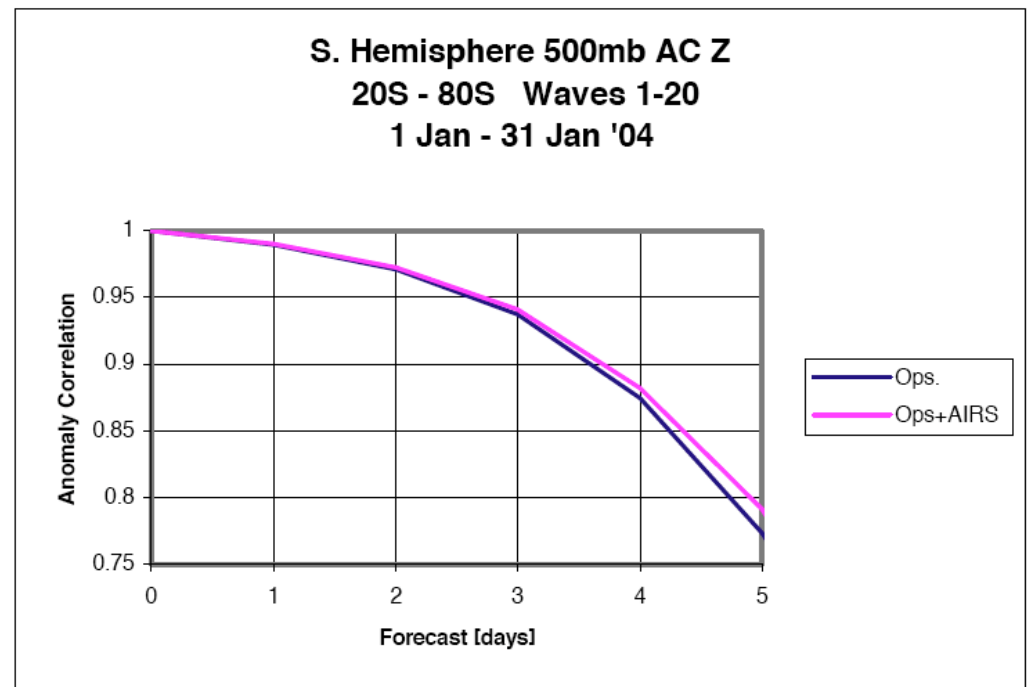
AIRS Processing Chain includes AIRS/IR, AIRS/Vis, AMSU, and HSB

Note: HSB ceased operating on 5 February 2003 at 21:50 UTC.

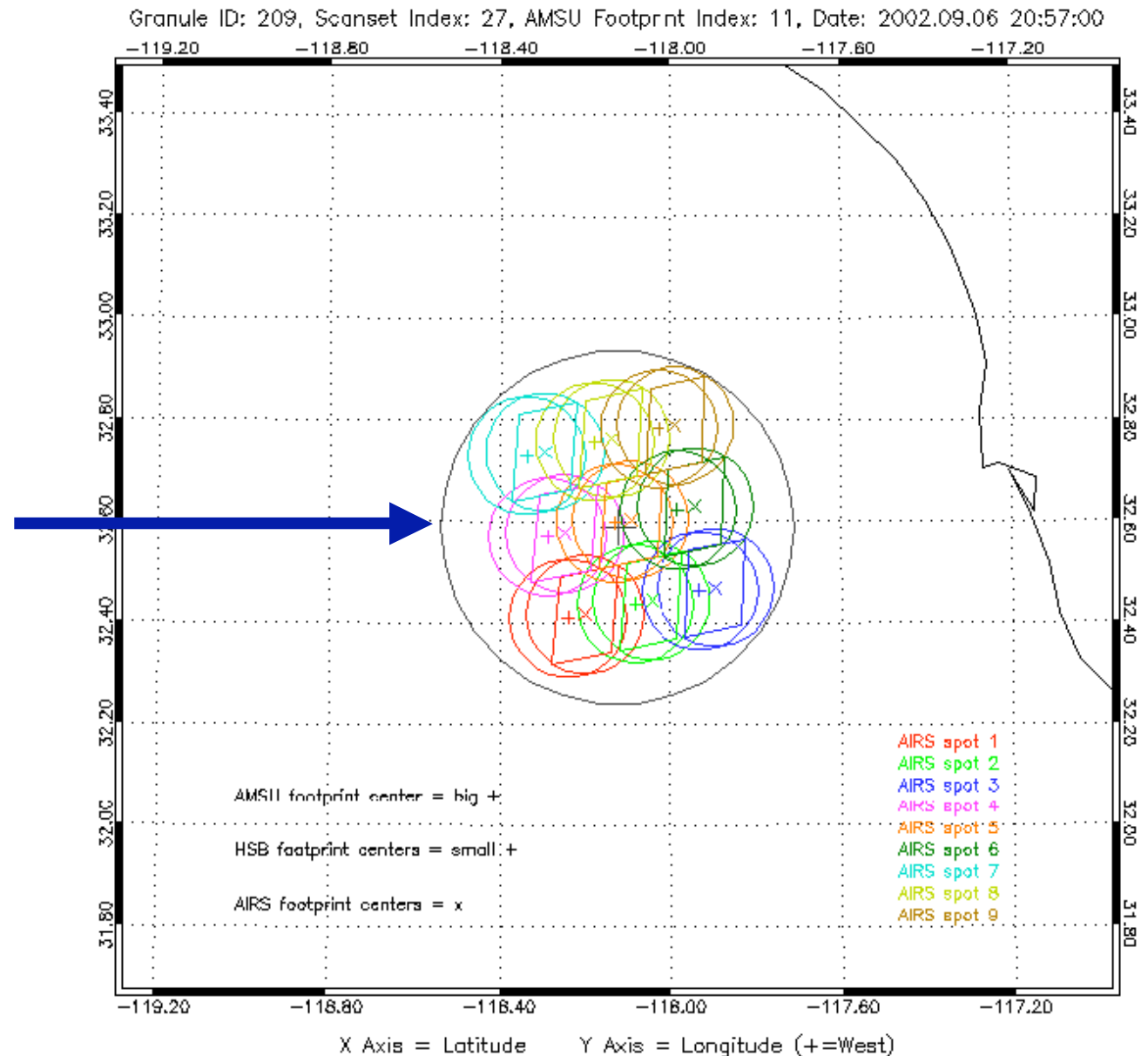**AIRS Level 2 processor reads corresponding Level 1B data granules from all instruments (AIRS IR, AIRS VIS, AMSU and HSB), the surface pressure from the NCEP forecasts*, and a digital elevation map.**

Software version is 4.0.9 (same as DAAC).

* Optional; minimal impact on retrievals

AIRS Level 2 retrievals are computed for each AMSU field of view (45 km diameter)

Each AMSU field of view (FOV) contains 3x3 AIRS FOVs

Granule ID: 209, Scanset Index: 27, AMSU Footprint Index: 11, Date: 2002.09.06 20:57:00

AMSU footprint center = big +

HSB footprint centers = small +

AIRS footprint centers = x

AIRS spot 1
AIRS spot 2
AIRS spot 3
AIRS spot 4
AIRS spot 5
AIRS spot 6
AIRS spot 7
AIRS spot 8
AIRS spot 9

X Axis = Latitude   Y Axis = Longitude (+=West)

AIRS Software Package for DB is based on official DAAC version with minimal changes

Processing is invoked by a single Python driver script. Python and Korn shell scripts manage low-level processing.

The package requires AIRS, AMSU, HSB, and GBAD Level 0 PDS files for input, where each file contains time ordered packets for a single Application Process ID (APID). The APIDs required from each instrument are as follows:

AMSU => APIDs 261, 262, 290
HSB => APID 342
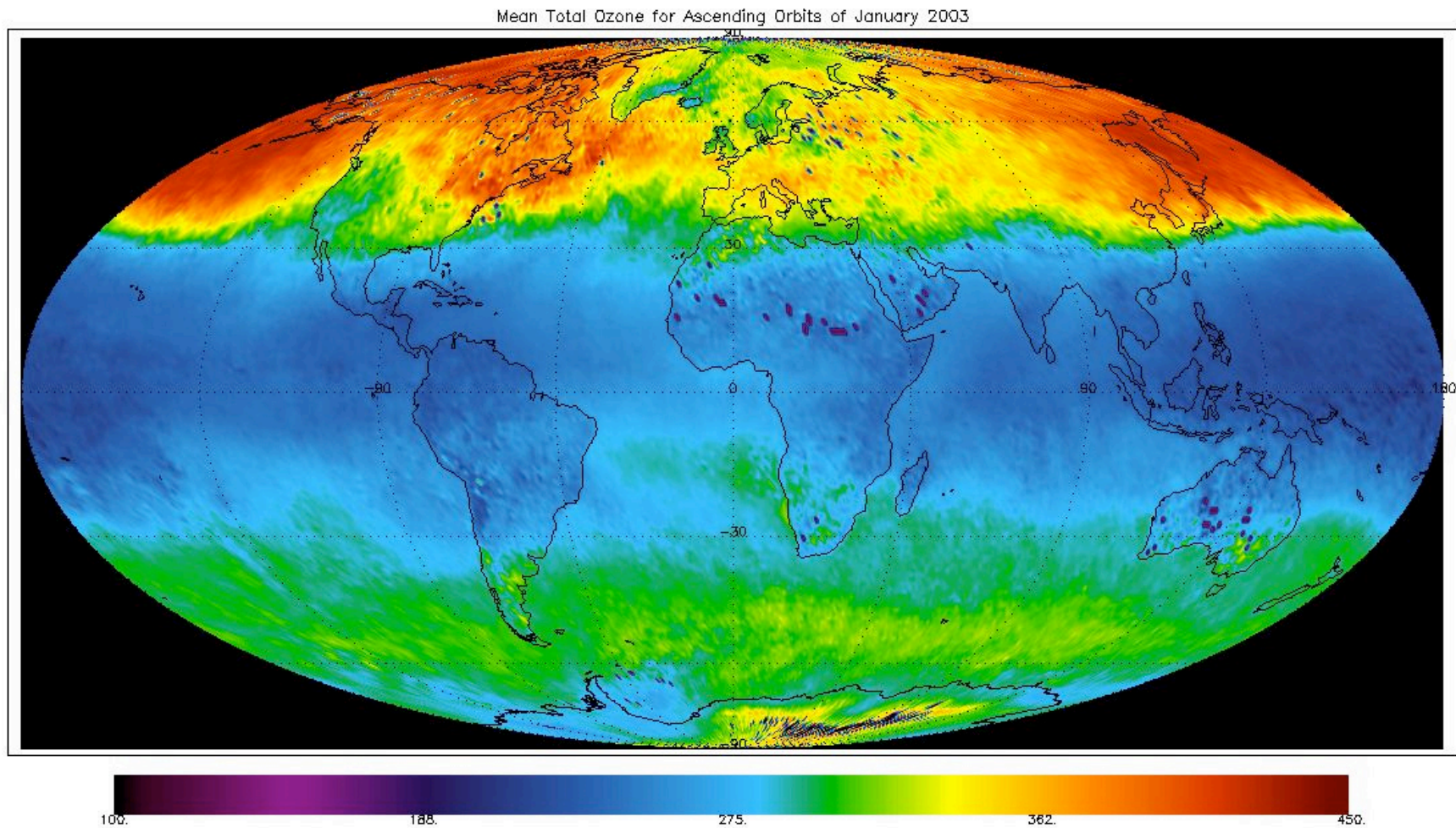AIRS => APIDs 404, 405, 406, 407, 414, 415
GBAD => APID 957

1. RT-STPS can be configured to write the required files.
2. Output granules are always 6 minutes long (same as DAAC).
3. Output format is standard HDF4 DAAC format.
4. Supported platforms are Linux (Intel) and Solaris (SPARC).
5. Binary distribution (JPL has promised source code).

Mean Surface Air Temperature
AIRS data, July 2003

July

Degrees Kelvin Over Land

243   253   263   273   283   293   303   313

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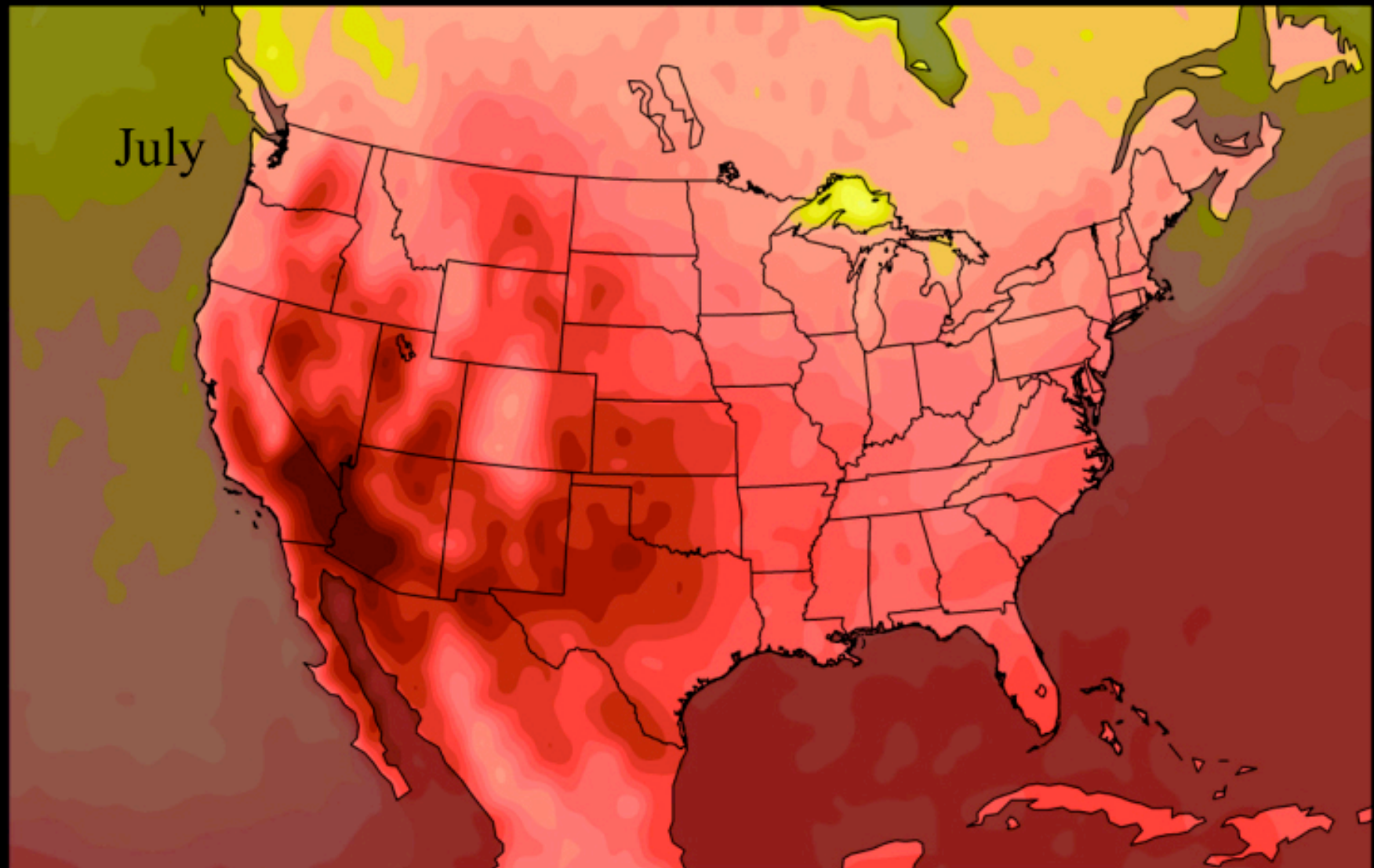
AIRS Total Ozone; Global Monthly Average (Jan 2003)

Mean Total Ozone for Ascending Orbits of January 2003

AMSR-E (Aqua) DB Software Updates

AMSR-E Level 1 & 2 software for DB was updated and released in 2005

Calibration and Geolocation code developed specifically for DB by Remote Sensing Systems.

Rain rate retrieval code adapted from AMSR-E GPROF B05 code by SSEC.

AMSR-E SST 2005/09/28

AMSR-E Sea Surface Temperature (K) 2005-09-28 ascending
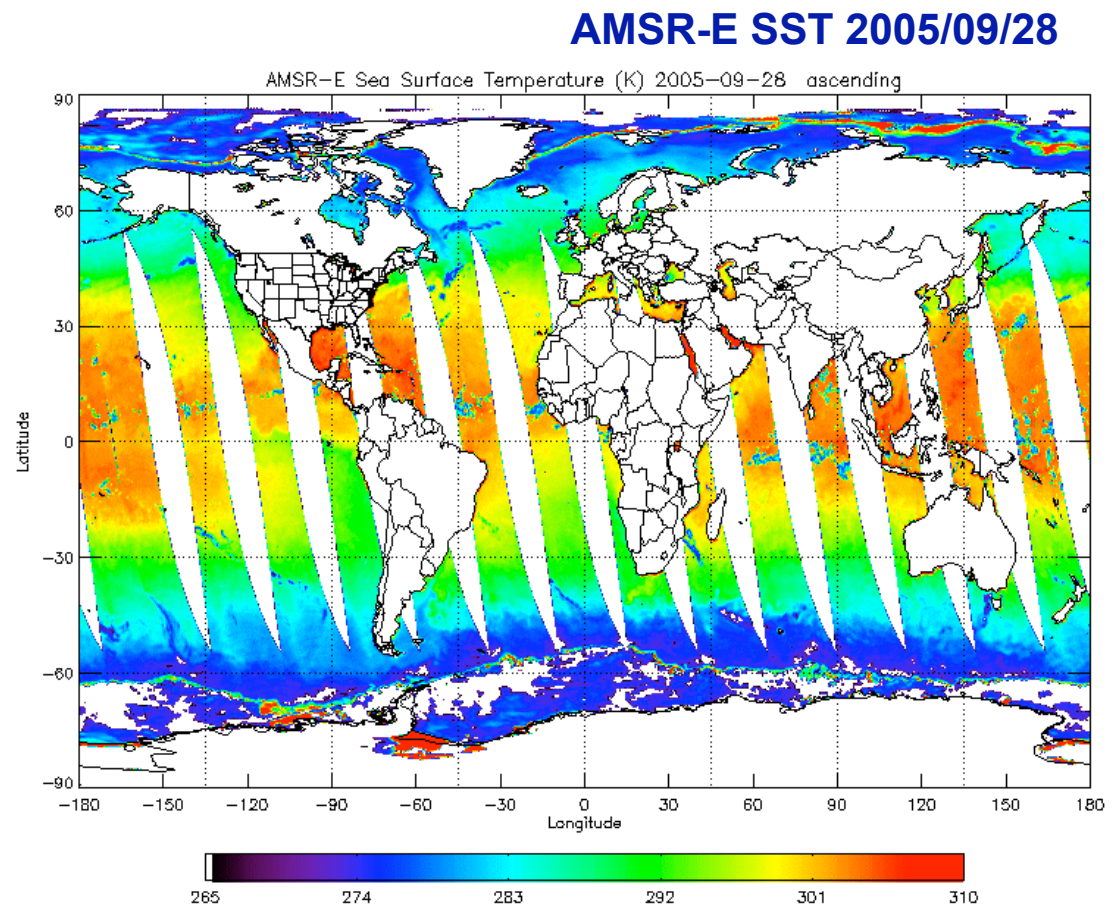
AMSR-E processing software for DB uses a real-time calibration and geolocation algorithm

GBAD data (APID 957) is read directly for geolocation (GBAD processor is not required).

Calibration algorithm is based on RSS global algorithm with hot load correction; except with static calibration tables. SSEC has verified the calibration by comparing DB vs.. DAAC AMSR-E data.

AMSR-E 89.0A GHz
horizontal polarization
2003/09/03
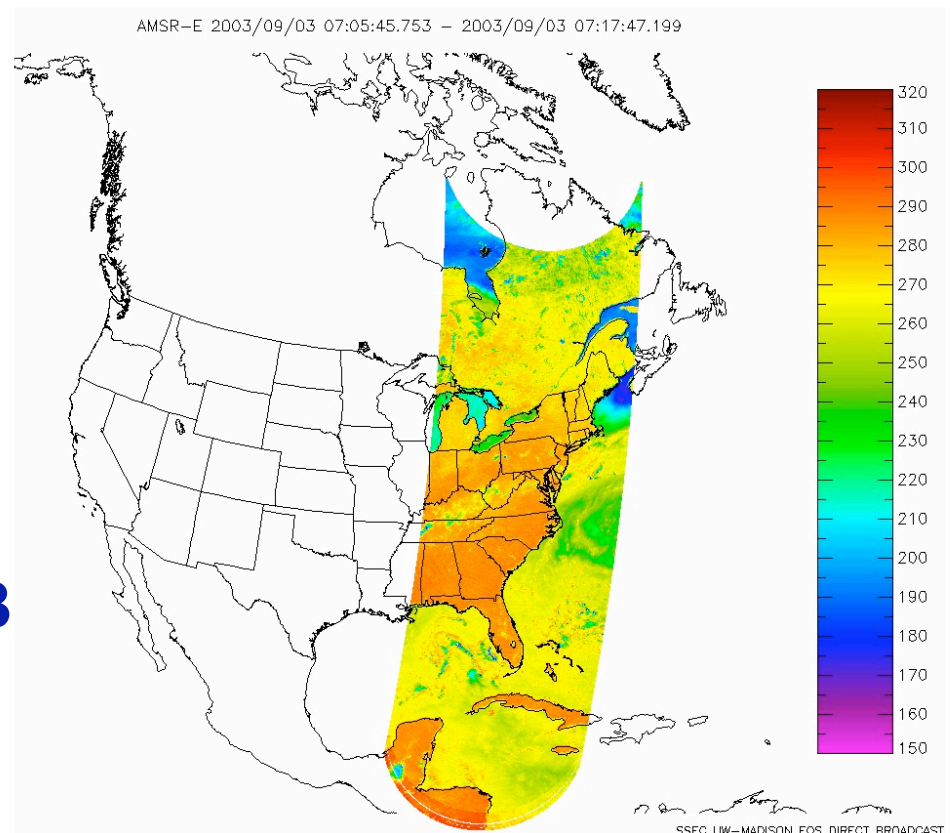
AMSR-E software package for DB is compact and very fast
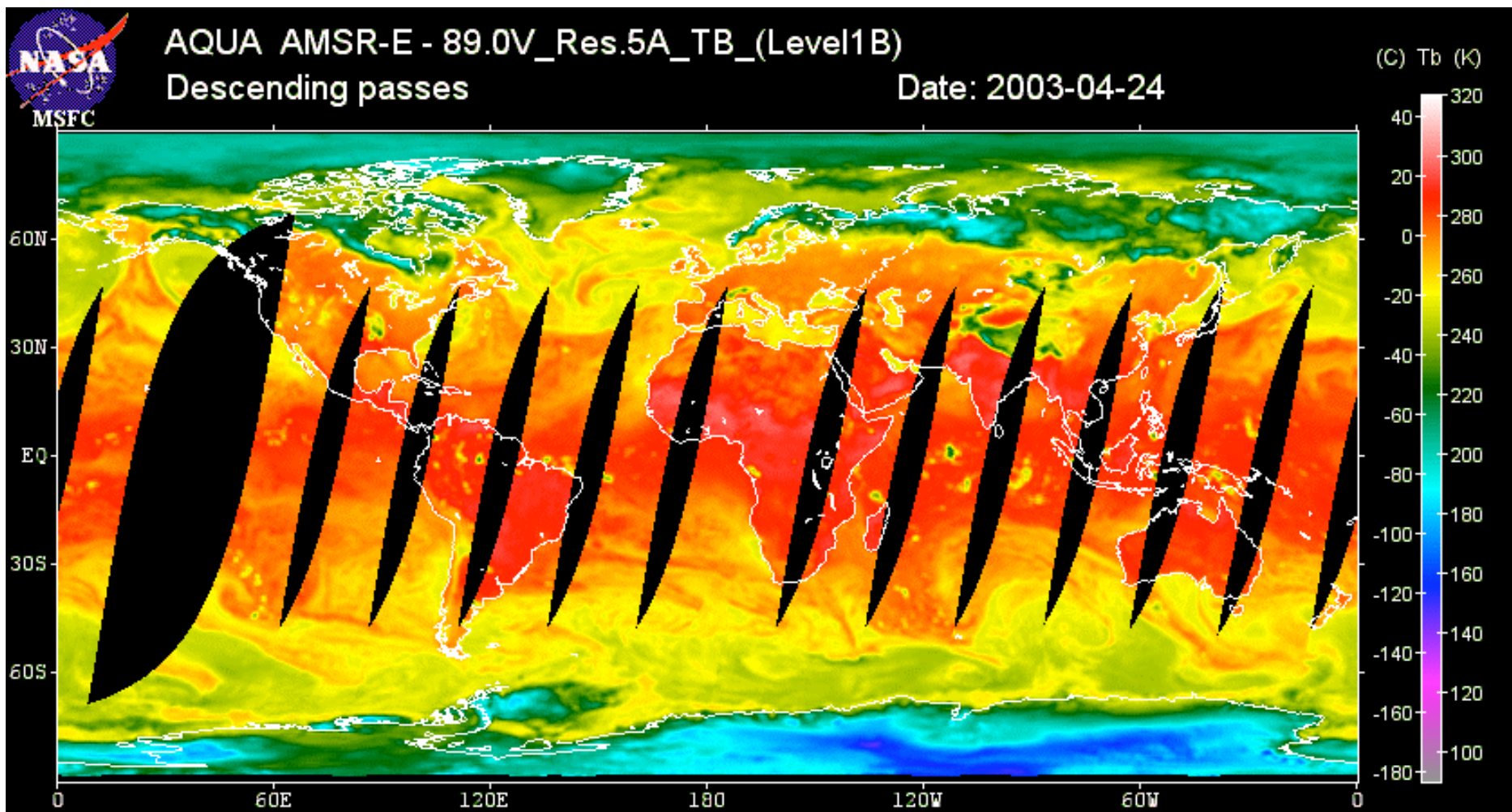
Level 1:

Binary-only release for Red Hat Linux and Solaris SPARC platforms. No source code is included, but it is available to US investigators on request. No ancillary files are required. Code typically runs in less than 15 seconds.

The output consists of two binary files:
1. Antenna temperatures for all channels and all resolutions
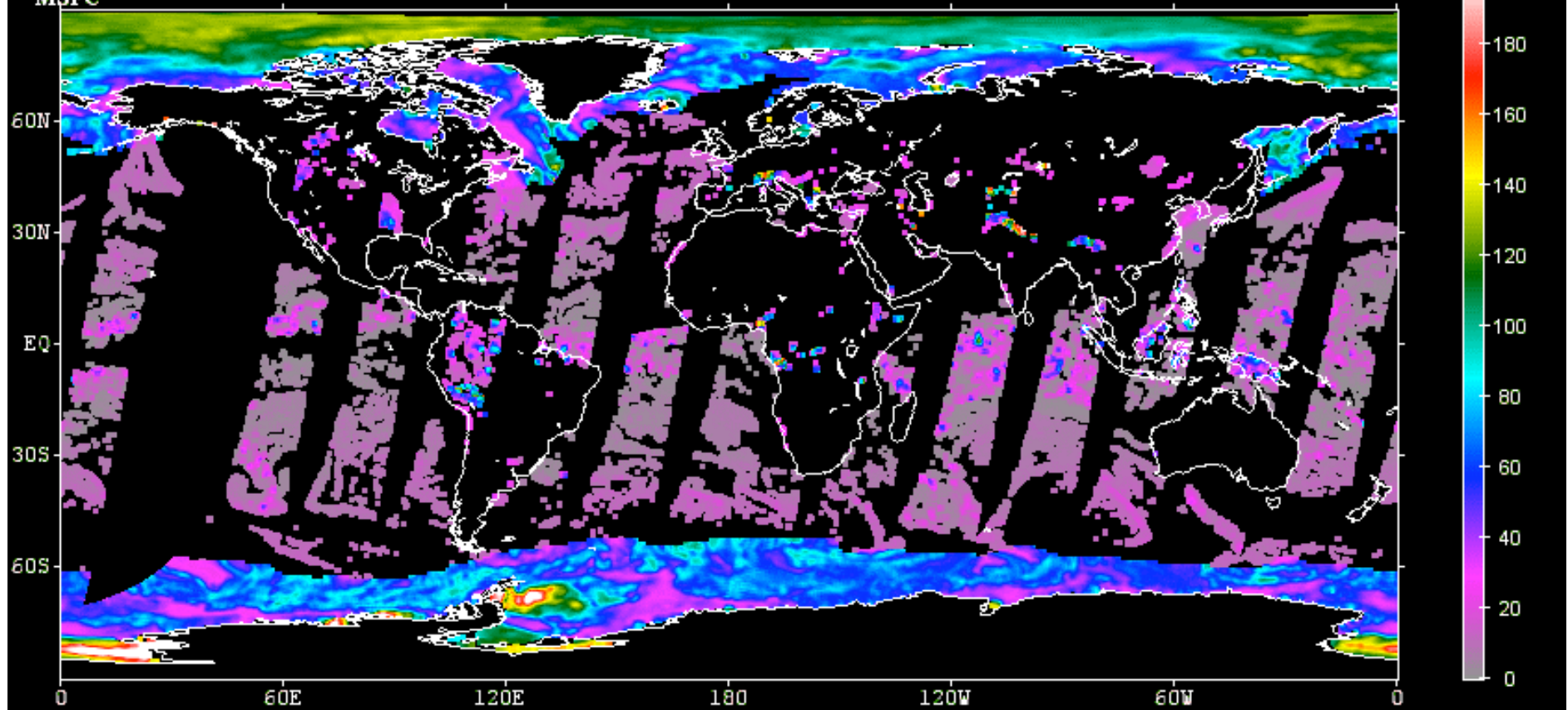2. Latitude, longitude, time, etc.

Level 2:

Source code release (FORTRAN 90); tested on Linux only. Reads swath input from DB Level 1, and writes standard AMSR-E rain rate/type product. No external ancillary data are required. Rain rate retrievals are produced over land and ocean.

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AQUA AMSR-E - 89.0V_Res.5A_TB_(Level1B)
Descending passes   Date: 2003-04-24

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Download Sites:

MODIS Level 1 DB package:

http://oceancolor.gsfc.nasa.gov/seadas/modisl1db/

MODIS Level 2, AIRS, AMSR-E packages:

http://www.ssec.wisc.edu/~gumley/IMAPP/

Summary:

EOS DB software packages continue to be updated and improved. Terra mission has been extended, and Aqua mission extension is likely. Continued maintenance will be necessary in the next 3-5 years.